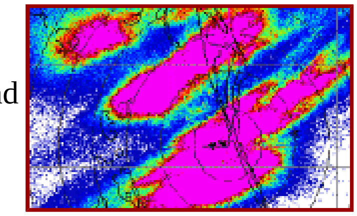
Lightning detectors watch storms that spawned tornadoes

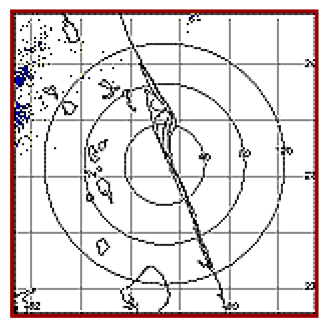
April 2, 1998: Lightning sensors in space and on the ground are showing the value of having a space-based network of sensors that could spot and track storms which are likely to spawn tornadoes.



Above, right: A map of lightning frequency during the February. 22-23 outbreak over Florida. Links to 400x533-pixel, 87K GIF. Credit: Global Hydrology and Climate Center.

Lightning is caused by warm, moist air rising rapidly through clouds. As the moist air rises, rain drops and ices form. The motion of the ice generates an electrical charge through friction, like shuffling across a carpet on a cold winter day. This process may also provide a warning sign of the energies that could be forming a twister.

Want to learn more about lightning? Check out the Global Hydrology and Climate Center's **lightning and atmospheric electricity research and education pages**.



Storms that sent tornadoes through Georgia in late March were observed from orbit by special sensors a few hours before and after they struck. And a ground-based network detected extensive lightning in storms that sent tornadoes through central Florida in late February. At least 15 people died in Georgia, and 40 in Florida, in the two storms.

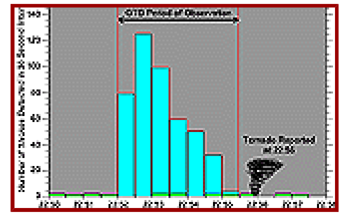
The animated GIF at right links to a 14-second quicktime(.mov) movie (480x520-pixel, 2.8MB) of LDAR data showing lightning frequency as the February 22-23 storm sweeps across Cape Canaveral, Florida. Credit: Global Hydrology and Climate Center.

The observations are part of a NASA project to develop a Lightning Mapping Sensor that could add up to 9 minutes to tornado warnings.

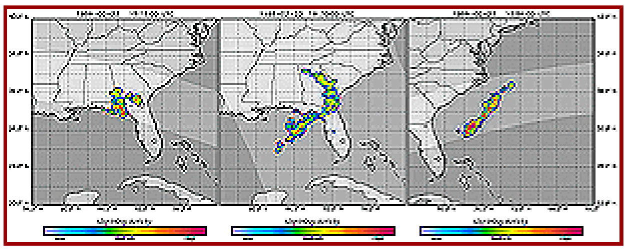
Dr. Steve Goodman, a NASA scientist at the Global Hydrology and Climate Center in Huntsville, Alabama., says that one of the instruments, the Lightning Imaging Sensor aboard the Tropical Rainfall Measurement Mission, is working well and returning good data. Because TRMM is a research mission in a low Earth orbit, it cannot provide real-time warnings of lightning and storms. But it could pave the way to such a system in the 21st century.

Scientists at NASA's Marshall Space Flight Center pioneered space-based lightning studies in the late 1980s by using cameras aboard the Space Shuttle to make striking images of lightning from above the cloud tops. In 1995, the Marshall-developed Optical Transient Detector was launched aboard MicroLab 1. Most recently, the Lightning Imaging Sensor, or LIS, was launched aboard TRMM on November 28, 1997.

The potential value of orbital observations of lightning was highlighted almost three years ago when OTD observed a storm over Oklahoma on April 17, 1995. OTD registered a sharp increase in lightning flashes as the storm system built, and as clouds rose, then a sudden drop as the system collapsed and spawned a tornado.



At right, a graph depicts the lightning flash rate observed by the OTD while it was over an Oklahoma storm cell on April 7, 1995 (It passed out of view just minutes before the twister touched down). Links to 704-655-pixel, 19K GIF. Credit: Global Hydrology and Climate Center.



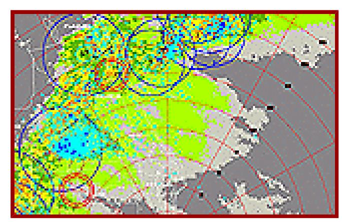
Where OTD is a demonstration mission, LIS is part of a suite of instruments carried by the Tropical Rainfall Measurement Mission satellite to observe storms in radar and infrared light.

At left is a series of images by showing lightning strikes before and after the February 22-23 tornado outbreak in Central Florida. Note that the lightning continued well out to sea. LIS, OTD, and LIS made the images. Links to 2,371x900-pixel, 112K GIF. Credit: Global Hydrology and Climate Center.

Unfortunately, neither satellite was over Florida at the height of the February 22-23 thunderstorms, but several ground-based instruments observed the activities.

As part of the campaign to verify that the LIS indeed sees everything it should, the LIS team has developed a Lightning Imaging Sensor Data Applications Display, or LISDAD, that collects data from Doppler weather radar in Melbourne, Florida., and lightning data from Kennedy Space Center's Lightning Detection and Ranging (LDAR) system and the National Lightning Detection System.

Through LISDAD, Goodman and his colleagues have compiled a movie showing the storm as it sweeps across central Florida and out to sea.



LISDAD combines data from LDAR lightning flashes (cyan) and NLDN ground strikes (blue) on a radar reflectivity map of the February 23 storm. Storm cell 8 is located in Seminole County north of the Orlando International Airport (MCO) approximately 100 km (62 mi) northwest of the Melbourne radar. Range rings are in 20 km (12 mi) intervals. The large circles encompassing each storm indicate the radius of uncertainty in LDAR flash location (a function of the distance from the LDAR antennas at KSC). The storm motion vectors and speed are shown next to each storm. Links to a 600x357-pixel, 98K GIF. Credit: Global Hydrology and Climate Center.

"We can see three mesocyclones [mid-size circulation patterns] forming at Daytona Beach and Volusia County," Goodman said. "We get big clusters of lightning activity, in the clouds at 3:20 a.m. onward. Then at 4 a.m. they decrease when the tornado develops."

When TRMM flew over the storm a few hours later, LIS could still see extensive lightning activity.

More recently, both OTD and LIS observed the March 21 storm that slammed Gainesville, Georgia, a few hours before and after the event and observed extensive lightning inside the system.

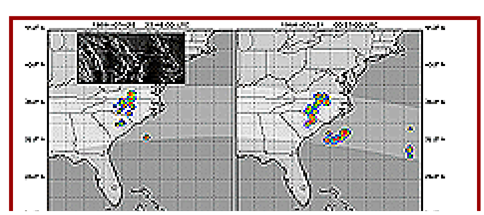


Image at right of March 21 storm links to 1,800x900-pixel, 108K GIF. Credit:

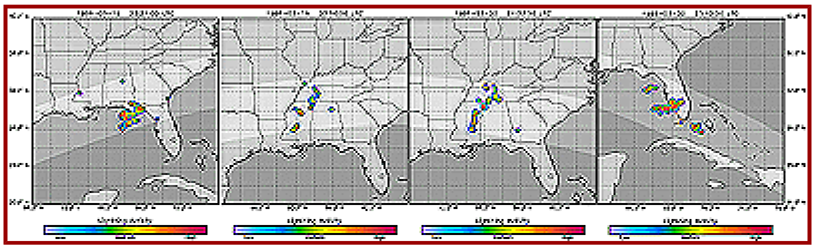
Global Hydrology Center.

Goodman said that that the observations by these various instruments strengthen the case for a Lightning Mapping Sensor in geostationary orbit where a special camera could zoom in on storms whenever they developed.

"It's not economically feasible to have LDAR everywhere," Goodman said, because it is a specialized system designed to protect the Space Shuttle. And the coverage by the National Lightning Detection System is too coarse to provide the kind of precision needed for precise storm warnings.

Thus, a geostationary weather satellite appears to be the best place for a storm spotter of the future. While satellites such as GOES-8 and -9 can track large storm systems, they produce images much slower than most storms systems develop.

Goodman and other LIS scientists are still analyzing data from the Florida and Georgia storms, like the March 19-20 storm that passed over the Southeast (below, links to 3,093x900-pixel, 131K GIF).



Credit: Global Hydrology and Climate Center.

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